
Risk Factors for Unplanned Readmissions in Older Adult Trauma Patients in Washington State: A Competing Risk Analysis



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BACKGROUND: Hospital readmission is a significant contributor to increasing health care use related to caring for older trauma patients. This study was undertaken with the following aims: determine the proportion of older adult trauma patients who experience unplanned readmission, as well as risk factors for these readmissions and identify the most common readmission diagnoses among these patients.

STUDY DESIGN: We conducted a retrospective cohort study of trauma patients age 55 years and older who survived their hospitalization at a statewide trauma center between 2009 and 2010. Linking 3 statewide databases, nonelective readmission rates were calculated for 30 days, 6 months, and 1 year after index discharge. Competing risk regression was used to determine risk factors for readmission and account for the competing risk of dying without first being readmitted. Subhazard ratios (SHR) are reported, indicating the relative risk of readmission by 30 days, 6 months, and 1 year.

RESULTS: The cumulative readmission rates for the 14,536 participants were 7.9%, 18.9%, and 25.2% at 30 days, 6 months, and 1 year, respectively. In multivariable models, the strongest risk factors for readmission at 1 year (based on magnitude of SHR) were severe head injury (adjusted SHR = 1.47; 95% CI, 1.24–1.73) and disposition to a skilled nursing facility (SHR = 1.54; 95% CI, 1.39–1.71). The diagnoses most commonly associated with readmission were atrial fibrillation, anemia, and congestive heart failure.

CONCLUSIONS: In this statewide study, unplanned readmissions after older adult trauma occurred frequently up to 1 year after discharge, particularly for patients who sustained severe head trauma and who could not be discharged home independently. Examining common readmission diagnoses might inform the development of interventions to prevent unplanned readmissions. (*J Am Coll Surg* 2015;220:330–338. © 2015 by the American College of Surgeons)

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The US population is aging, with the elderly increasing both in absolute number and as a proportion of the total population. Elderly patients are over-represented in the trauma population. In Washington State, the annual number of patients aged 65 and older in the state trauma registry has increased from 4,266 in 2000 to 11,226 in 2012, corresponding to an increase in the percentage of the population that sustains trauma from 30% to 42% (Washington State Department of Health, unpublished data). In contrast, in 2013, persons aged 65 and older made up only 13.6% of the overall state population.¹

Advanced age often predicts inferior outcomes after trauma, both in morbidity and mortality.²⁻⁴ Factors that might contribute to poor outcomes include comorbidities,^{5,6} increased severity of injury,^{7,8} and lack of physiologic reserve.⁹ Although the age cutoff commonly used

Abbreviations and Acronyms

AIS	=	Abbreviated Injury Scale
CHARS	=	Comprehensive Hospital Abstract Reporting System
FIM	=	Functional Independence Measure
ISS	=	Injury Severity Score
SHR	=	subhazard ratio
SNF	=	skilled nursing facility

to define a geriatric patient is 65 years, worse outcomes after trauma have been documented in patients starting at age 55 years.^{3,7}

Older adult trauma places a burden on the health care system that is increasingly relevant as government and private funders recognize and attempt to curtail the increasing costs of medical care. Hospital readmission is a substantial contributor to this financial strain,^{10,11} and it has also been posited as a measure of quality of care.^{12,13} As a result of these concerns, in 2012, the Affordable Care Act instituted the Hospital Readmissions Reduction Program, allowing the Centers for Medicare and Medicaid Services to reduce payments to hospitals for perceived excess readmissions.¹⁴

Factors that contribute to readmission have been studied extensively in certain medical populations^{13,15}; however surgical patients (including trauma patients) have not received the same level of attention.¹⁶⁻¹⁸ In light of the increasing demand placed on the health care system by older adult trauma, and to inform further policy discussion, we undertook this study with the following aims: determine the proportion of older patients who require unplanned readmission after hospitalization for trauma, as well as risk factors for these readmissions, and identify the most common readmission diagnoses among older patients requiring readmission after trauma.

METHODS**Setting, participants, and data sources**

This retrospective cohort study included all trauma patients aged 55 years and older who were residents of Washington State and whose admission was captured by the Washington State Trauma Registry between January 2009 and December 2010. The Trauma Registry is an inclusive registry containing data from 81 designated trauma centers (Level I to V). Submission to the registry is required for all patients who have a traumatic diagnosis (ICD-9 diagnosis codes 800-904, 910-959, 994.1, 994.7, or 994.8) and one or more of the following: a full or modified trauma team activation; death on arrival to the facility; death within the facility; transfer out to another

facility by Emergency Medical Services; transfer in from another facility by Emergency Medical Services; flown directly from the scene to the facility; all pediatric patients (aged 0 to 14 years); and all adult patients (aged 15+ years) with a facility length of stay >48 hours. Patients with isolated hip or femoral neck fractures and patients with isolated burns were excluded from this study. Only patients who survived their index trauma admission and were at risk for readmission were included. The registry provided patient and injury characteristics, as well as features of the index trauma admission. The earlier literature is not consistent with respect to the strata used for age when examining older adult injury,^{9,17,19} therefore, the current study used the following strata: 55 to 64, 65 to 74, 75 to 84, and 85+ years. Trauma center level was stratified as I/II vs III/IV/V, in keeping with earlier work within Washington State.²

To determine readmissions that occurred after trauma, the Trauma Registry was linked to the Comprehensive Hospital Abstract Reporting System (CHARS), a state-wide database that contains hospital discharge information. The CHARS database includes all acute care hospitalizations in the state, allowing capture of readmissions to hospitals other than the index facility. As this study sought to examine both short- and long-term readmissions, CHARS data were included through December 2011. Only the first nonelective readmission after index trauma hospitalization was included (identified by categorization in CHARS) to maintain a focus on unexpected rehospitalizations. Cumulative readmission rates were then calculated for 30 days, 6 months, and 1 year after discharge from the index hospitalization. The Comprehensive Hospital Abstract Reporting System also provided ICD-9 diagnosis codes for the readmissions of interest. The 20 most common diagnostic codes for readmissions during each time interval were examined and the 10 most common are reported here.

To ensure that readmission rates were not biased by deaths that occurred after the index trauma hospitalization, the Trauma Registry and CHARS datasets were further linked to the Washington State Death Registry. Due to the use of competing risk analysis (see Statistical Analysis), we were interested in deaths that occurred out of hospital, without the patient first having been readmitted. We did not include deaths that occurred during a readmission, or deaths that occurred out of hospital after a readmission. Therefore, at each time point, we calculated the cumulative number of readmissions, the cumulative number of deaths that occurred without having been readmitted to hospital, and the cumulative number of people who survived without having been readmitted to hospital. The primary outcomes of the study included

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